Turkish Journal of Agriculture - Food Science and Technology, 11(2): 192-196, 2023
DOI: https://doi.org/10.24925/turjaf.v11i2.192-196.4835

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

Exploring the Possibility of Chickpea (*Cicer arietinum* L.) Growing as Second Crop under Uşak Ecology

Ali Kahraman[1,a], Ünal Buğdaylı[1,b,*]

[1]*Department of Field Crops, Faculty of Agriculture, Selcuk University, Konya, Türkiye*
[*]*Corresponding author*

ARTICLE INFO

Research Article

Received : 08/11/2021
Accepted : 09/01/2023

Keywords:
Crop rotation
Farming chickpea
Legumes
Sustainable agriculture
Turkiye

ABSTRACT

Tends on human nutrition changes every day but legumes act significant role in nutrition over the World. Chickpea (*Cicer arietinum* L.) is a member of *Leguminosae* family and originated from Asia. Chickpea is rich in protein, carbohydrate, lipid and minerals. It is also sufficient for Daily requirement by view of the essential amino acids – lysine, leucine and arginine. Chickpea is also source of soluble and insoluble fibers. The nutritional fibers favor decreasing the time food passes through the intestine, accelerating weight loss, reducing total and LDL cholesterol, and balancing blood sugar levels. Sustaining of agriculture is essential for sustainability of life. From this perspective, chickpea is quite important due to various agronomic advantages that may be summarized by main ones are; able to grow as winter crop, lower water requirement, wide adaptation ability to climate and soil, a good alternative for crop rotation systems in addition to health care features. Present research is realized to evaluation of second crop growing facilities in Uşak/Türkiye ecology by using 4 chickpea genotypes (Azkan, Hisar, Sarı-98, Yaşa-05) by 4 sowing time (18th June, 02nd July, 16th July, 30th July) by 3 replications. The following measurements were realized; days to emergence, days to flowering, days to harvest, height of plant, number of pods per plant, number of seed per pod, height of first pod, seed yield and weight of hundred seeds. According to the results Yaşa-05 chickpea genotype was determined as the most adaptable in addition to the Azkan chickpea genotype was also obtained as promising to growing as second crop. Deep and long-term studies are needed to achieve more consistent results and provide sustainability of food security, improvement of soil, better usage of natural sources, and contribute to the national economy.

[a] akahraman200064@hotmail.com https://orcid.org/0000-0003-3203-4697 | [b] unalbugdayli@gmail.com https://orcid.org/0000-0002-2387-8137

Introduction

Chickpea (*Cicer arietinum* L.) a member of legumes (*Fabaceae* – *Leguminoseae* Family), rich by mineral content and cultivation is realized almost all around the world. Health care status and protein amount, symbiotic nitrogen fixation mechanism, soil improvement characteristics, less water demand, able to be grown as winter crop are the main factors that make chickpeas a sustainable concept reaching the plant.

The origin of the chickpea is known in South Asia, including Türkiye; residues belong to 3000 B.C., and cultivation has been made for a long time. Seed components are averagely as following; 21% protein ratio, 60% carbohydrate, 5.9% oil, 7% fiber. Total stach ratio is about 32-57% and 20-46% of starch is amylose. Rich by mineral components while lycine, losin and arginine amino acids are sufficient for essential daily requirement (Minarro Vivas, 2013). Chickpea is a source of soluble and insoluble fiber, which accelerates weight loss, decreases total and LDL cholesterol, and regulates blood sugar levels (Bosaeus, 2004; Howarth et al., 2001). Additionally, resolution, retention of water and oil, swelling, gel formation and emulsification etc. various technological characteristics which are the quality of end products, are affected by dietary fibers (Elleuch et al., 2011).

Among legumes, chickpea is the most cultivated and produced crop in Türkiye that is followed by lentil, bean and faba bean (Ton et al., 2014). According to FAO statistical database (FAO, 2019), Türkiye has 3.76% of world chickpea production with 514.415 ha area, 74 kg da^{1} yield and 630.000 tons of production. Türkiye had 8.780.000 ha chickpea area, 100 kg da^{-1} yield and 855.000 tons of production which means 41% decrease in area and 26% decrease in production. Uşak City has the third place in Türkiye by view of sowing area ratio (8.14%) and production ratio (8.46%).

Chickpea is an essential legume traditionally grown in marginal areas and salty soils (Salami and Ahmadi, 2010). Most of the chickpea grown places face to especially anthracnose (*Ascochyta rabiei*) (Kahraman and Ozkan, 2015) due to early spring time sowing that is welded by insufficient precipitation. For the other regions that have irrigation opportunities and/or have sufficient irrigation on the desired period, growing chickpea as second crop is a good option to achieve various sustainability principles. Furthermore, the winter cropping of chickpeas in favorable climatic zones is also an exemplary implementation. A previous study (Mazid et al., 2009) evaluated adoption of winter chickpea growing technology and effects in Syria. In 2006, a total of four cities were subjected to survey by chickpea farmers. It was reported that, chickpea growing as winter crop realized and still expanding on those days. In the second region where has 250-350 mm annual precipitation showed significant increase. All the producers reported that they got more yield on winter cropping than summer cropping. Depending on higher yield, household incomes increased and positive effects detected relatively higher among poor farmers. There were two more advantages of winter cultivation of chickpea; water productivity and an increase in labor demand, especially for women's employment.

For the mentioned statutes of sustainability principles such as food security and supply, health care statutes, symbiotic nitrogen fixation mechanism, environment friend crop, soil improvement characteristics, wide adaptation ability, low input requirement, effective usage of sources and economic contribution, chickpea is essential to take part in crop rotation programs. Therefore, present research was realized in Uşak – Türkiye ecology to evaluation of different sowing times and chickpea genotypes as second crop growing.

Materials and Methods

Field trial of the present research was conducted in Ulubey Town/Uşak-Türkiye. Sowing of the seeds was realized on 4 different dates: 18th of June, 02nd of July, 16th of July and 30th of July in 2017. As material, a total of 4 chickpea genotypes were used that the population characterized genotypes: Azkan, Sarı-98 and Hisar in addition to the certified variety Yaşa-05.

The trial area consisted of 4 Sowing times X 4 Chickpea genotypes X 3 Replications which equals to 48 total plots. Each plot had a 3m length, 2 m width and so 6.0 m^2 area. Spaces between plots were 0.5 m, block spaces were 2 m while sowing density was 40 cm X 15 cm by 5 lines.

Trial was set up according to randomized blocks design while main plots consisted from sowing times and subplots were by chickpea genotypes. The first two sowing times were realized following barley and wheat harvests. The rest of sowing times were realized to assess the situation.

Ulubey Town has a transition climatic characteristic between Aegean and Central Anatolian regions. Continental climate prevails in the region. Summers are warm, winters are long and harsh. Annual precipitation is between 430 mm and 700 mm with an average of 532 mm. the lowest temperature is -24°C and the highest temperature is +39.8°C. Most of the precipitation falls in the winter, but in the summer time, precipitation is very little. Irrigation was realized 3 times in total.

Climatic data for the research year (2017) is presented on Table 1.

A general evaluation of the soil analyzes showed that; high potassium, very little phosphorus, much limy, slightly alkali and clay loam saturation. Tillage was made by plow for two times after harvest of the barley and then rototiller was used to prepare the seed sowing bed. A total of 15 kg da^{-1} 20.20.0 (36 SO_3) fertilizer was applied to the plots and mixed to soil by harrow.

Following characteristics were realized: Time of emergence (day), time of flowering (day), time of vegetation (day), height of plant (cm), number of pods per plant, number of seed per pod, height of first pod (cm), seed yield (kg da^{-1}), weight of 100 hundred seed (g).

In the present research, there were some missing data depending on the environmental factors, used chickpea genotypes besides sowing times that had no sufficient seed on the plots. So, the present research results are reported by the average values.

Results and Discussion

Results of the present research are shown as mean values due to some missing data, which are welded by short vegetation period, genetic structure and the time of seed sowing. Mean of the investigated parameters in this study are presented in Table 2.

A general evaluation of the present research is summarized in this part according to Table 2. Hisar genotype had the highest value for days to emergence all the sowing times. Yaşa 05 was the most adapted genotype to climatic conditions. The fastest value for days to flowering was obtained from Yaşa 05 genotype (32nd day). The earliest pod formation was on Yaşa 05 genotype (38th day). The highest height of plant value acquired from Hisar genotype while the lowest value was on Yaşa 05 genotype. The highest value for seed yield was detected on Yaşa 05 genotype.

Table 1. Climatic data for vegetation period*

Months	Temperature (C)	Relative Humidity (%)	Total Precipitation (Mm)
June	19.86	52.69	70.4
July	24.80	38.48	0.0
August	23.18	47.75	39.0
September	21.55	33.79	1.2
October	13.05	51.32	54.4
November	8.15	59.18	28.2
Average/Total	18.43	47.20	193.2

*Climatic data provided from; Turkish State Meteorological Service

Table 2. Mean of the investigated parameters of chickpea genotypes that were sown on different times as second crop in Uşak – Turkey ecology

Days to emergence (Unit: Day)

Genotype/ Sowing time	First sowing (18.06.2017)	Second sowing (02.07.2017)	Third sowing (16.07.2017)	Fourth sowing (30.07.2017)	Mean
Hisar	-	7.00	7.00	8.00	7.33
Azkan	7.00	7.00	-	8.00	7.33
Sarı 98	-	-	-	8.00	8.00
Yaşa 05	7.00	7.00	-	-	7.00
Mean	7.00	7.00	7.00	8.00	7.42

Days to flowering (Unit: Day)

Genotype/ Sowing time	First sowing (18.06.2017)	Second sowing (02.07.2017)	Third sowing (16.07.2017)	Fourth sowing (30.07.2017)	Mean
Hisar	-	61.00	88.67	49.00	66.22
Azkan	65.00	55.67	-	54.33	58.33
Sarı 98	-	-	-	51.00	51.00
Yaşa 05	48.64	39.67	-	-	44.16
Mean	56.82	58.335	88.67	48.5	54.93

Days to harvest (Unit: Day)

Genotype/ Sowing time	First sowing (18.06.2017)	Second sowing (02.07.2017)	Third sowing (16.07.2017)	Fourth sowing (30.07.2017)	Mean
Hisar	-	146.00	146.00	146.00	146.00
Azkan	132.00	132.00	-	132.00	132.00
Sarı 98	-	-	-	118.00	118.00
Yaşa 05	146.00	104.00	-	-	104.00
Mean	139.00	136.66	146.00	125.00	125.00

Height of plant (Unit: cm)

Genotype/ Sowing time	First sowing (18.06.2017)	Second sowing (02.07.2017)	Third sowing (16.07.2017)	Fourth sowing (30.07.2017)	Mean
Hisar	-	20.80	29.60	31.30	27.23
Azkan	27.67	26.73	-	32.00	28.80
Sarı 98	-	-	-	22.57	22.57
Yaşa 05	27.51	23.67	-	-	23.67
Mean	27.59	23.73	29.60	28.62	25.57

Number of pods per plant (Unit: Number)

Sowing time/Genotype	Azkan	Yaşa 05	Mean
First sowing (18.06.2017)	-	12.37	12.37
Second sowing (02.07.2017)	9.00	13.00	11.00
Mean	9.00	12.685	11.685

Number of seed per pod (Unit: Number)

Sowing time/Genotype	Azkan	Yaşa 05	Mean
First sowing (18.06.2017)	-	1.00	1.00
Second sowing (02.07.2017)	1.00	1.00	1.00
Mean	1.00	1.00	1.00

Height of first pod (Unit: cm)

Sowing time/Genotype	Azkan	Yaşa 05	Mean
First sowing (18.06.2017)	-	16.50	16.50
Second sowing (02.07.2017)	16.00	16.33	16.17
Mean	16.00	16.42	16.67

Seed yield (Unit: kg da^{-1})

Sowing time/Genotype	Azkan	Yaşa 05	Mean
First sowing (18.06.2017)	-	88.36	88.36
Second sowing (02.07.2017)	39.30	114.18	76.74
Mean	39.30	101.27	82.55

Weight of hundred seeds (Unit: g)

Sowing time/Genotype	Azkan	Yaşa 05	Mean
First sowing (18.06.2017)	-	34.67	34.67
Second sowing (02.07.2017)	32.33	36.00	34.17
Mean	32.33	35.34	34.42

Ranges of the investigated data in the previous researches were reported as following; Phenological values by Bayrak (2010) were 15.17- 23.17 for days to emergence, 45.66 – 61.66 for days to flowering, 90.33 – 105.33 for days to harvest; 18.40-38.90 (Güner and Sepetoğlu, 1994), 22.60-47.30 (Müderriszade, 1996), 24.40 (Azkan et al., 1999), 23.83-37.76 (Erdin and Kulaz, 2014), 20.33-36.67 (Ceran and Onder, 2016) for number of pod per plant; 24.20-42.00 cm (Eser et al., 1989), 59.90 cm (Azkan et al., 1999), 41 cm (Yaşar, 2012), 39.63-48.26 cm (Erdin and Kulaz, 2014), 34.67-57.33 cm (Ceran and Onder, 2016) for plant height; 13.00-33.60 cm (Eser et al., 1989), 35.90 cm (Azkan et al., 1999), 15 cm (Yaşar, 2012), 22.56-24.96 cm (Erdin and Kulaz, 2014), 15.33-27.67 cm (Ceran and Onder, 2016) for first pod height; 1.00-1.23 (Eser et al., 1989), 0.96-1.44 (Müderriszade, 1996), 1.10 (Azkan et al., 1999), 0.84-1.26 (Ceran and Onder, 2016) for number of seed per pod; 98.00-178.20 (Saxena, 1981), 132.00-281.00 (Güner and Sepetoğlu, 1994), 142.10-277.80 (Müderriszade, 1996), 40.70-203.30 (Çiftçi and Türk, 1998), 168.20-185.90 (Azkan et al., 1999); 158.00-205.00 (Tayyar et al., 2008), 78.14-154.12 (Bayrak, 2010), 156.00-203.00 (Aydoğan, 2012), 97.70-153.93 (Erdin and Kulaz, 2014), 182.63-277.77 (Ceran and Onder, 2016) kg da^{-1} for seed yield; 12.60-48.10 g (Eser et al., 1989), 25.80-27.90 g (Güner and Sepetoğlu, 1994), 35.21-48.97 g (Müderriszade, 1996), 29.35-44.40 g (Çiftçi and Türk, 1998), 41.46 g (Azkan et al., 1999), 30.63-47.56 g (Erdin and Kulaz, 2014), 34.67-43.44 g (Ceran and Onder, 2016) for one hundred seed weight. Differences in the investigated values in the present research might be welded by genetic variation of the used chickpea genotypes besides climatic conditions and cultural applications that are quite important in plant growth.

Conclusions

Present research was realized to evaluation possibility of chickpea growing as second crop in Uşak/Türkiye conditions. Data collected from the research showed that Yaşa 05 genotype and Azkan genotype are promising and reached to favorable seed yield values. Future studies on this perspective may be focused on determination of chickpea performance at different sowing times.

Türkiye is one the most important countries in the world by mean of production and export of chickpea and lentil. In recent years, this situation tends to decrease. Various climatic conditions of Türkiye are mostly suitable to chickpea farming. So, the production potential should be evaluated by taking care; breeding of high quality and potential yield varieties, effective disease/weed/insect control, standard size, ability to afford demands of foreign markets, using feasible and current cultivation techniques, expanding of cultivation especially for winter growing and/or second crop. Principles of sustainability include medical statues, gluten-free diet, high protein, qualified amino acid, food security in the nature of cheap price-easy access-easy storage and transportation for both human and animal. Additionally, no pollution to environment, improvement of soil characteristics, favorable to crop rotation program, high adaptation ability, low input to growing, improvement and increasing effectiveness of time-natural resources-labor-energy-economic statues, that are take part by legume farming and crop rotation systems may be possible to adopt application of different farming techniques consider to sustainable agricultural systems.

References

Aydoğan A. 2012. Determination of yield and quality traits of normal and simple leaved kabuli chickpea (*Cicer arietinum* L.) cultivars and lines). MSc Thesis, Institute of Natural and Applied Sciences, Ankara University, Ankara, Türkiye.

Azkan N, Kaçar O, Doğangüzel, E, Sincik M, Çöplü N. 1999. Bursa ekolojik koşullarında farklı ekim zamanlarının nohut hat ve çeşitlerinde verim ve verim öğeleri üzerine etkisi. Proceedings of Türkiye 3rd Field Crops Congress, Adana, Türkiye, 15-18 November 1999, 3: 318-323.

Bayrak H. 2010. Determining agricultural, technological and nutritional characteristics of local populations and varieties of chickpea cultivated in Konya ecology. PhD Thesis, Institute of Natural and Applied Sciences, Selcuk University, Konya, Türkiye.

Bosaeus I. 2004. Fibre effects on intestinal functions (diarrhoea, constipation and irritable bowel syndrome). Clinical Nutrition Supplements, 1(2):33-38.

Ceran F, Önder M. 2016. Determination of some agricultural characteristics on chickpea (*Cicer arietinum* L.) cultivars that are sown at different periods. Selcuk Journal of Agriculture and Food, 3(1): 25-29.

Çiftçi V, Türk Z. 1998. Güneydoğu Anadolu koşullarında ekim zamanının nohutta verim ve verim öğelerine etkisi. Proceedings of East Anatolian Congress, Türkiye, 14-18 September 1998, 1: 483-487.

Elleuch M, Bedigian D, Roiseux O, Besbes S, Blecker C, Attia H. 2011. Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. Food chemistry, 124(2): 411-421.

Erdin F, Kulaz H. 2014. Van–Gevaş ekolojik koşullarında bazı nohut (*Cicer arietinum* L.) çeşitlerinin ikinci ürün olarak yetiştirilmesi. Turkish Journal of Agricultural and Natural Sciences, 1: 910-914.

Eser D, Geçit HH, Emeklier HY, Kavuncu O. 1989. Nohut gen materyalinin zenginleştirilmesi ve değerlendirilmesi. TUBİTAK Journal of Agriculture and Forestry, 13(2): 246-254.

FAO, 2019. Food and Agricultural Organization of the United Nations. FAOSTAT. Available from: http://faostat.fao.org [Accessed 09 February 2019.

Güner Ü, Sepetoğlu H. 1994. Nohutta yazlık ve kışlık ekim ile bitki sıklığının besin elementleri alımı, büyüme ve verime etkileri üzerine bir araştırma. Proceedings of Field Crops Congress, Agronomy, İzmir, Türkiye, 25-29 April 1994, 1: 105-108.

Howarth NC, Saltzman E, Roberts SB. 2001. Dietary fiber and weight regulation. Nutrition reviews, 59(5): 129-139.

Kahraman A, Ozkan Z. 2015. Ascochyta blight of chickpea. Selcuk Journal of Agriculture and Food Sciences, 29(2): 62-66.

Mazid A, Amegbeo K, Shideed K, Malhotra RS. 2009. Impact of crop ımprovement and management: winter-sown chickpea in Syria. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, 52s, Syria.

Miñarro Vivas B. 2013. Development of gluten-free bread formulations (Doctoral dissertation). Universitat Autònoma de Barcelona.

Müderriszade HÖ. 1996. İri ve orta taneli nohutlarda büyüme verim ve verim öğeleri ile bunlar arasındaki ilişkiler. MSc Thesis, Institute of Natural and Applied Sciences, Ege University, İzmir, Türkiye.

Salami P, Ahmadi H. 2010. Energy inputs and outputs in a chickpea production system in Kurdistan, Iran. African Crop Science Journal, 18(2): 51-57.

Saxena MC. 1981. ICARDA Research Highlights, p. 27–29.

Tayyar Ş, Egesel CÖ, Gül, KM, Turhan H. 2008. The effect of autumn and spring planting time on seed yield and protein content of chickpea genotypes. African Journal of Biotechnology, 7(11): 1655- 1661.

Ton A, Karaköy T, Anlarsal AE. 2014. Problems and solutions of pulses production in Türkiye. Turkish Journal of Agriculture - Food Science and Technology, 2(4): 175-180.

Yaşar M. 2012. Penetrance and expressivity of double podding characteristics in chickpea (*Cicer arietinum* L.). MSc Thesis, Institute of Natural and Applied Sciences, Akdeniz University, Antalya, Türkiye.